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A COLLECTION OF FOSSIL FISHES IN THE UNIVERSITY OF KANSAS FROM THE NIOBRARA FORMATION OF THE CRETACEOUS.....*David Starr Jordan.*

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A Collection of Fossil Fishes in the University of Kansas, from the Niobrara Formation of the Cretaceous.

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NINE fossil fishes from the Niobrara formation of Cretaceous age have been sent to me for examination by Prof. Handel T. Martin, curator of vertebrate paleontology in the Dyche museum of natural history, University of Kansas. Notwithstanding the large collections already made from this region, five of these represent undescribed species. In all but two of these examples the body is better preserved than the head.* Most of the related species thus far described from the Niobrara are known from jaws and other fragments only—a fact which renders comparison difficult or impossible.

The provisional restorations of five of these species is the work of William Sackston Atkinson, natural history artist of Stanford University.

FAMILY ANOGMIIDÆ.

ANOGMIUS Cope.

(Type *Anogmius contractus* Cope.)

? Anogmius Cope. Proc. Amer. Phil. Soc. 1870, 170. (*A. contractus.*) Fragments of head from Niobrara formation.

Anogmius Cope. Proc. Amer. Phil. Soc. 1878, 178. (*contractus,* with two additional species.)

Anogmius Stewart. Geol. Surv. Kan. 1900, 340. (*Beryx polymicrodus* Stewart.) Perhaps not Anogmius Cope (1870). *A. contractus* Cope being, according to Cope, perhaps a fragment of *Pachyrhizodus.*

? Tyryptodus Loomis. Palæontographica, XLVI, 1900, 229. (*T. zitteli* Loomis.) Part of a skull from Niobrara formation.

? Pseudothryptodus Loomis. Loc. cit., 236. (*P. intermedius* Loomis.) Same locality; regarded by Stewart as part of the maxillary of *Anogmius;* by Loomis as a ceratohyal.

* It appears that when the head is more or less intact its bones are in general destroyed. When single bones, as the jaws or opercles, are detached, they are well preserved. Perhaps oil or some other substance in the brain cavity causes neighboring bones to disintegrate, even when originally strong and firm, as in scorpænoid fishes.

This genus, as yet incompletely known, is based on parts of the skull of a very large fish. It is characterized, especially among clupeiform fishes, by the long and strong jaws, each covered with a mass of very short, equal, pitlike teeth, by the very strong ribs, and by the long, deeply caudal fin, of which the branching rays of the inner part of each lobe are very widely expanded.

The use of the name *Anogmius* for this genus may be open to question. It was defined by Cope, in 1870, from fragments he later referred to *Pachyrhizodus,* suggesting at the same time that if the American species of that genus should prove distinct from the European type (*basalis*) they might stand as *Anogmius. Pachyrhizodus* Dixon (1850) is regarded by Woodward as a synonym of *Raphiosaurus* Owen (1842).

Later (Proc. Am. Phil. Soc. 1878, 178) Cope seems to have changed this opinion, for he observes: "The characters of the genus *Anogmius* Cope having up to the present time rested upon but one species (*A. aratus*—a slip for *A. contractus*), it is satisfactory to confirm them by the study of new material." (*Anogmius evolutus* and *A. favirostris* Cope.) In view of this consideration, I follow Stewart in the use of the name *Anogmius.*

The family relationships of *Anogmius* are not clear. Stewart places it with the Osteoglossidæ, and Woodward, with not much better reason, among the Albulidæ. It is perhaps related to the genus *Plethodus,* which has similarly weak and numerous teeth. In the present chaotic state of the family arrangement of these genera of Cretaceous clupeiform fishes, *Anogmius* may well be the type of a distinct family.

1. *Anogmius polymicrodus* Stewart.

Beryx polymicrodus Stewart. Kan. Univ. Quart., VII, 195, 1898. (Jaws from western Kansas.)

Anogmius polymicrodus Stewart. Univ. Geol. Surv., VI, 1900.

Of this species I have received several fragments (No. 273), three of which I figure—the caudal fin, a maxillary, and a dentary (Plate XIII). The last is very broadly winged below and behind and covered above with a broad mass of minute teeth. I have also fragments of the sides of the body showing the very strong ribs.

The caudal fin closely resembles Stewart's figure (LXVI), evidently belonging to the same species. The upper lobe is broken, but the lower is perfect, its length being 11 inches. The diameter of a caudal vertebra is five-sixths of an inch. These are constricted, much deeper than long, coarsely and irregularly striate, rapidly reduced in size backward, the last four or five neural and hæmal spines

forming fulcra which increase rapidly in length behind. Caudal rays 15 + 15, much more numerous than shown in Stewart's figure; the first three short, perhaps to be regarded as fulcra; the next five slender, progressively lengthened and not branched; the next two a little longer, much widened, and profusely branched, each having from eight to fifteen branches, giving the rays a broomlike appearance. The next five rays are progressively shorter, but still more flattened and still more finely divided, from the middle outwards. Fourth long ray abruptly shorter than the third. Hypural well developed, much wrinkled, truncate at tip.

This specimen differs from Stewart's figure of the tail of *Anogmius polymicrodus* in having five shortened brushlike rays instead of three and in having the uppermost simple ray about as long as the longest brushlike rays. It may be that in Stewart's example the inner rays of each lobe had been cut off. The basal bones of the fulcra do not cross over or hide the last few vertebræ as in *Niobrara encarsia.*

A dentary bone (No. 283) of the mandible, probably from the same species, is somewhat broken, 5¾ inches long, very broad, and with a very broad striated wing below; its ridged striatious, resembling coarse fin rays, widening posteriorly and extending the whole length of the bone. The whole dentary surface of the bone is covered with fine, even, close-set granulations or teeth of equal size, in about twenty obscure vermiculate rows, none of them sharp. These teeth are rather to be defined as little rounded pits in a harder matrix, well shown in Stewart's figure. The wing below the mandible is very much broader and longer than is shown in Stewart's plate (LXVII) of *Anogmius evolutus.* The tooth-bearing surface is flattened in front, wider in the middle, and overhanging on the sides. Another bone figured also, five inches long, is more slender, but of precisely the same nature, the band of teeth much narrower, the striations similar, the middle with a prominent compressed wing. This I take to be a maxillary. Other fragments show the very strong ribs of the species.

The other nominal species of this genus, all from Niobrara deposits in western Kansas—*A. contractus* Cope and *A. evolutus* Cope —are known from bones of the head only. *A. evolutus* seems to be distinct from the present species, having the lower jaw narrower and much less strongly winged. *A. contractus* is so scantily known that it cannot be compared with the others. The name *A. aratus* Cope seems to be a slip for *contractus,* as noticed by Stewart. (U. S. Geol. Surv. Kan., 344, 1900.)

FAMILY NIOBRARIDÆ.

Those genera of large fishes which in the Cretaceous preceded the modern Clupeidæ, Engraulidæ and Dussumieriidæ have been referred, almost at random, to different families, as the Albulidæ, Chirocentridæ, Pterothrissidæ, Osteoglossidæ and Crossagnathidæ, and even to the Clupeidæ and Salmonidæ. Of these living families, but one, Pterothrissidæ, has a many-rayed dorsal. In this respect the genus *Niobrara* agrees with *Pterothrissus*. Presumably the others which we associate with *Niobrara* may have the dorsal similarly formed, but we do not yet know. But comparing *Niobrara* with *Pterothrissus gissu*, a common food fish of southern Japan, we find little else to indicate affinity. *Pterothrissus* has a slender body, little compressed, pectorals low down on the side, the lower side of the head with strong mucous cavities, the mouth small and inferior, the anal relatively few-rayed, inserted well behind the ventrals, the caudal widely forked and with numerous fulcra.

One extinct genus, *Istieus* Agassiz, of Europe, shows various traits of resemblance to *Pterothrissus*, and may belong to the Pterothrissidæ, but none of these genera of the Kansas Cretaceous shows much affinity with either, and they may be provisionally joined to form the family Niobraridæ.

NIOBRARA Jordan, new genus.

(Type *Niobrara encarsia* Jordan.)

Body elliptical in form, compressed, tapering to a very slender caudal peduncle, which bears a long and deeply forked caudal fin; mouth moderate, with short jaws, the teeth apparently small, in one or two rows; scales large, smooth; vertebræ about 52, each deeper than long, much constricted, and with three shallow ridges and furrows; basic bones of the caudal fulcra decussating across the last vertebræ and the hypural. Dorsal fin many-rayed, beginning not far behind the head, elevated in front; anal fin obliterated, its interspinals beginning at end of body cavity, before tip of ventrals, the fin no doubt many-rayed; body cavity one-fourth longer than head; ventrals strong, inserted midway between middle of head and base of caudal; pectoral long, inserted high on the sides; caudal widely forked, its rays relatively few and strong, much branched at tip, with few fulcra.

Niobrara encarsia Jordan, n. sp.

No. 179. From the Niobrara Cretaceous, Trego county, Kansas. Collector, Harry Martin. (Plate XIV.)

A fine, large fish, complete and well preserved, except for the disintegration of the bones of the head, which cannot be made out in detail. Length, with caudal, 27 inches.

Head 6⅙ times in length to base of caudal; depth, 4½; caudal peduncle, 5; maxillary, about 3 in head; mandible, 2⅓; pectoral fin, about 1¼ in head, its rays about 12; ventral, 2¾ in head, its rays 8; caudal lobes, 1⅕ in head, the developed rays 6 + 6 = 12; vertebræ, 20 + 31 = 51; dorsal rays, about 10 + 30 = 40; anal rays, probably 24 to 28.

Body elliptical elongate, deepest midway, with very slender caudal peduncle; sides considerably depressed, the ventral outline sharp, and perhaps serrate. Head so twisted towards the left and modified that few separate bones can be traced; eyes apparently small, location not evident; frontals each with a blunt projection; mouth moderate, the jaws apparently equal, the teeth almost wholly obliterated, a few traces of the small teeth on mandible; preopercle narrow, striate, with broadly obtuse angle; opercle rather sharply striate.

Scales all lost, except in a patch on sides of breast; those large, thin, smooth or slightly striate; vertebræ strong, deeper than long, mesially depressed, largest on the very slender caudal peduncle; anterior vertebræ with three shallow furrows, the posterior ones even above or with very slight longitudinal ridges; these vertebræ much deeper than long, those on the caudal peduncle with peculiarly arranged fulcra, their basal spines crossing the last vertebræ and the hypural. Caudal fin divided nearly to its base; its rays relatively few, strong, and much divided; upper fulcral neurals longer than lower. Ribs very long and strong, curved, each with a median furrow.

Dorsal fin inserted not far behind head, in front of middle of pectoral; neural spines strong, recurved; no evident interneurals; anterior rays of dorsal long, thick, flexible, tapering upward and curved, the longest 1⅔ in head; about 10 long rays; posterior part of fin probably made up of low rays, of which no trace is left; anal fin probably very long, beginning midway between base of the pectorals and that of caudal, just before tip of ventrals. About nine anterior rays provided with strong interneurals, rather long, each

with a vertical groove; the fin rays entirely destroyed, but probably numerous; the fin high in front and very low posteriorly. Body cavity one-fourth longer than head.

Pectoral fin long, reaching nearly two-thirds distance to ventrals, its tip broken; the two upper rays strong, but not greatly enlarged; the insertion high; no free spine; ventrals strong, inserted posteriorly midway between middle of head and base of caudal with broad ridged pelvic plate, the outer rays strongest, the rays much branched at tip, the distance from gill opening 1⅓ times length of head. Caudal fin of two very long, narrow acute lobes, each of few rays very slender at tip, the fin spreading widely, apparently with fulcra at base, these partly lost, their basal bones singularly formed, crossing the hypural.

Name from ἐγκάρσιος, crosswise.

ZANCLITES Jordan, new genus.

(Type *Zanclites xenurus* Jordan.)

Body elongate-elliptical; moderately compressed with very slender caudal peduncle, and long, deeply forked caudal, the rays very slender and somewhat recurved; mouth small (the teeth and most bones of the head obliterated); vertebræ strong, about 56 in number; ribs very strong, grooved; last vertebræ not covered by interspinals.

Dorsal fin (obliterated) apparently long and low, many rayed; anal very long, as appears from the strong interhæmals; pectoral inserted rather high, short and broad, with twelve rays, none of them enlarged; ventrals very small and weak, six-rayed, inserted in middle of body. Body cavity about one-fourth shorter than head, interhæmals very long and strong, beginning close behind ventrals, the space presumably occupied by anal fin, half length from tip of snout to base of caudal; caudal of long and slender rays, which are little branched, the basal fulcra not crossing and hiding the last vertebræ as in *Niobrara*.

Zanclites xenurus Jordan, n. sp.

Type No. 52. Niobrara Cretaceous; one-half mile northeast of Gove City, Gove county, Kansas. Collector, Harry Martin. (Plate XV.)

A fine specimen, well preserved, except for the head and nape, and its dorsal and anal fins; length, 21½ inches, with caudal.

Head, 3½ in length to base of caudal; depth 3⅗; depth of caudal

peduncle, 3¾ in head; maxillary, about 4¼ in head; pectoral, about 2 in head; ventral, 8; caudal lobes about one-fifth longer than head; dorsal rays, about 50; anal, about 30; pectoral rays, about 12; ventral, 6; caudal, 16 + 12 = about 28, besides 6 to 8 fulcra on either side. Vertebræ, 18 + 38 = 56.

Body elliptical-elongate, apparently compressed, the ventral outline narrowed but no evidence of scutes; caudal peduncle slender, but less so than in *Niobrara*.

Head so crushed that few separate bones can be traced; eyes quite small; apparently shorter than snout; mouth rather small, its cleft about one-fourth length of head; jaws apparently equal, the teeth obliterated except for a single row of very small ones along edge of maxillary; preopercle short, striate; opercle large, much striate, rugose below.

Vertebræ strong, deeper than long, scarcely enlarged on caudal peduncle, the anterior vaguely striate or ridged, the median with a blunt process on the anterior lower part of each, this wanting on vertebræ of the peduncle, which are finely ridged; ribs long and strong, little curved, most of them with a median furrow; neural spines very strong, but short.

A little patch of scales behind pectorals and another on nape, these thin, smooth and well embedded, with traces of rivulations along the surface; probably about 50 in a series along sides, judging from their size; dorsal fin wholly obliterated, but probably long and low, judging from traces of interneurals; its insertion midway between eye and base of caudal; anal fin obliterated, but from traces of interneurals I infer, that its form was similar, its base about half length of body, its insertion midway between eye and base of caudal.

Pectoral fins apparently short and quite broad, not reaching ventrals, the rays quite slender, none of them widened. Ventrals very small, of slender rays, inserted near end of second fifth of body, not including caudal; pelvic bones small. Caudal very deeply forked, but not divided to base; the lobes long, narrow and pointed, the rays very slender, the upper lobe branchlike and curving outwards; base of fin slightly heterocercal; base of fin with numerous fulcra.

This fish is evidently allied to *Niobrara encarsia*, differing mainly in the small weak ventrals, the short, broad pectoral, the caudal, equally deeply forked, but with many more rays and these curiously recurved. It may lack the elevated dorsal of *Niobrara*, but this is not certain.

KANSANUS Jordan, new genus.

(Type *Kansanus martini* Jordan.)

This genus, known only from the head and shoulders of a large fish, seems to be allied to *Niobrara* and *Zanclites*, with which it agrees in general form and in the large, thin, cycloid scales, roughened somewhat, however, along the concentric striæ. It differs in the much larger mouth, the cleft half length of head, and stronger teeth in few rows, as also in the long, pointed pectoral fin, which is two-thirds length of head.

4. *Kansanus martini* Jordan, n. sp.

Type No. 128. From the Niobrara Cretaceous, six miles southeast of Gove City, Gove county, Kansas. Collector, Harry Martin. (Plate XVI.)

The head and pectoral fin of a large fish, with a few vertebræ, the head so crushed as to make identification of most of the bones uncertain.

Head rather deep, showing no occipital crest; snout moderately acute; mouth very large, its cleft straight, about half the length of head; lower jaw apparently somewhat included; a rather strong mandible with a median furrow, its edge with an irregular row of moderate conical subequal teeth; maxillary narrow. Bones of skull above rugose, striated, their outlines not traceable. A few large, smooth, thin scales evident on shoulder; these cycloid, finely striate, with very minute points over the surface of the striæ. Vertebræ behind head strong, deeper than long, the upper surface with two longitudinal striæ with four or five deep, rounded pits above. Actinosts rather strong; pectoral fin long, pointed, inserted high, with slender rays, 8 to 10 of them preserved, the upper longest, the fin about 1½ in head; none of the rays thickened. One pharyngeal bone preserved, oblong, quadrate, with very small, bluntish teeth.

LUXILITES Jordan, new genus.

(Type *Luxilites striolatus* Jordan.)

This species, known from the head alone, is distinguished by the small even teeth in its large mouth; by the large, deep, closely imbricated scales, suggesting those of the cyprinoid genus *Luxilus*, by the fine striation of its scales, by the coarser striation of most bones of the head; the presence of rough tubercles, resembling small scales, on the skin between the opercle and the subopercle and be-

tween the uppermost branchiostegals. Pectoral narrow, without greatly enlarged rays, inserted high, opposite lower part of opercle.

The relation of this genus are obscure, but it cannot be very far from *Kansanus* and *Niabrara*.

5. *Luxilites striolatus* Jordan, n. sp.

No. 295. Niobrara Cretaceous. A head badly broken, with some ribs, a few vertebræ and the base of the pectoral. Length of head about four inches. (Plate XVII.)

Body apparently compressed, covered, as far as seen, with smooth, closely imbricated scales, much deeper than long, each with very fine, lengthwise striæ. Preopercle broad, crescentic, set obliquely, with strong, diverging striæ at its angle, and other strong striæ below and above; the main shaft of the bone smooth; suborbital bones strong, quadrate; mandible broken, apparently rather strong; maxillary rather broad, smooth, its edge with a row of fine, even sharp teeth, whether in more than one row cannot be seen, these short and not very close set; mouth ending about under middle of eye; coarse prominences behind eye; opercle rather small, with rather fine striæ running downward and backward, its upper parts covered with small tubercles resembling scales; similar roughnesses in a patch separating the opercle from the subopercle, which is broad, smooth, finely striate and horizontally placed. Branchiostegals well exhibited (eleven distinct) probably fifteen in all, the upper broad and flat, parallel with the subopercle and growing progressively narrower downward, some small scalelike tubercles between each of the uppermost pairs; outline of the branchiostegal region forming an even curve. Shoulder girdle rather narrow, its bones, so far as seen, striate. Pectoral fin placed high, opposite lower part of opercle; the fin broken, the upper ray thickest; ten rays present, with no sign of more. Eight stout ribs present, these covered by the scales. The few vertebræ preserved are smallish, deeper than long, not much constricted.

FERRIFRONS Jordan, new genus.

(Type *Ferrifrons rugosus* Jordan.)

This genus seems to have much in common with *Niobrara*, differing in the hard casquelike covering of the head above the bones; this with the exposed parts of the shoulder girdle everywhere roughened with fine, blunt points or irregularly vermiculated striæ and in the low insertion of the pectorals. The body is very deep and compressed, tapering rapidly backward to a stoutish tail, which bears

a long, widely forked caudal somewhat like that of *Niobrara*. The scales are moderate, thickened, roundish, and with surface rough with small points. The pectoral and ventral fins are moderate in size, the dorsal and anal apparently many-rayed, the rays probably slenderer, the dorsal beginning over middle of head.

The low insertion of the pectoral fin in this genus, common to most physostomus fishes, separates it rather sharply from the Niobraridæ, but I know of no other place for it. The bony casque suggests certain living Osteoglossidæ, which, however, *Ferrifrons* resembles in no other respects.

6. *Ferrifrons rugosus* Jordan, n. sp.

Type No. 296. A very large fish from the Niobrara Cretaceous, four miles northeast of Gove City, Gove county, Kansas. Collector, Harry Martin. Length, 24½ inches. (Plates XVIII and XIX.)

The specimen is in fair condition except the loss of the front of the head, including the snout and both jaws. The posterior part of the body is damaged and has been restored in plaster; the dorsal and most of the anal fin is wanting, the dorsal in the type being restored as in the genus *Phareodus*, which I am convinced is an incorrect interpretation, as the dorsal interneurals begin over the middle of the head not far behind the eye.

Head 3⅘ in length to base of caudal; greatest depth half length; dorsal and anal rays probably numerous; ventral rays, 6 or more; pectoral, 7 or more; caudal, $15 + 15 = 30$; the lobes as long as head; vertebræ about $25 + 40 = 65$; ribs, 18.

Body very deep, strongly compressed, pear-shaped in outline, the depth greatest just behind head, thence tapering backward to a short, rather thick caudal peduncle. Head deeper than long, its upper parts covered with a casque of thick bone, rugose with blunt points arranged in irregular wavy striæ; opercle and exposed part of shoulder girdle similarly rough with fine wavy striæ. Opercle moderate, about as deep as long. Orbit small, about 7 in head. Mouth entirely lost, but probably not large, as the joint of the quadrate bone to which the mandible was attached is just below middle of eye. Other bones of head so crushed as not to be certainly traceable. Ribs very strong, long, mostly channeled, covering a large abdominal cavity. Shoulder girdle crescentic. Neural bones high, those above shoulder long and slender, bearing equally long and slender interneurals. This indicates probably a rather high dorsal, beginning with one of the first interneurals just behind the

head. Posteriorly all the interneurals are lost, not represented in the plaster restoration. Anal fin apparently many-rayed; the interhæmals mostly lost, the first being very long, lanceolate, broadened below; a few anterior anal rays only present, these rather strong, indicating a very long fin somewhat elevated in front. Neural and hæmal bones generally long and strong.

Pectoral fin placed unusually low, with conspicuous actinosts, the fin mostly obliterated, but probably of moderate size. Ventral fins rather small, probably inserted just before middle of body, but in the type torn loose and adherent to the anal fin, the posterior rays of the latter being also misplaced and adherent to the side of the body. Caudal fin very long, widely and deeply forked; its lobes equal, pointed, as long as head; the outer rays 2½ times length of inner; all very slender, the basal interneurals covering the last vertebræ, which are turned upward as if heterocercal, but perhaps through distortion; rays all very slender.

Scales mostly lost, of moderate size (probably 50 to 60 in a longitudinal series) of rather thick texture, the surface rough with small points, as is the case with the bones of the head.

FAMILY SYLLÆMIDÆ.

APSOPELIX Cope.

Apsopelix Cope. Ann. Rept. U. S. Geol. Surv. Terr. 424, 1870. (*sauriformis.*) Benton Cretaceous.

?*Pelocorapis* Cope. Bull. U. S. Geol. Surv. Terr. 1874, 587, 1877. (*varius.*) Benton Cretaceous, at Sibley, Kan.

?*Leptichthys* Stewart. Amer. Geol., XXIV, 78, 1899. (*agilis.*) Niobrara Cretaceous. Logan county, Kansas.

We see no difference of importance to distinguish the genera *Apsopelix* and *Leptichthys*, except the anterior position of the dorsal in *Leptichthys*. But as the fin is not preserved in any specimen of *Apsopelix*, its position being indicated only by traces of slender interneurals, we do not know how much stress should be given to this difference. Our specimen shows a few weak interneurals above the ventrals, suggesting supposed place of the dorsal in *Apsopelix*. It is not impossible that the two genera may prove to be inseparable. *Pelocorapis*, also from the same district, is not very different from *Apsopelix*, which name, being older than the others, should be preserved should any or all prove to be identical with it.

This genus is perhaps related to *Syllæmus*, but I doubt if either belongs to the Crossognathidæ. The very low insertion of the pectorals and the backward position of the ventrals exclude all of these

fishes from the Percesoces, in which suborder Woodward places the Crossognathidæ. Cope puts *Syllæmus* with the Mugilidæ, an arrangement apparently quite impossible. In general appearance *Apsopelix* approaches the *Albulidæ*, but in *Albula* the inside of the mouth has large grinding teeth, while the jaws have feeble teeth only. For the present we may accept Syllæmidæ as a distinct family, near Albulidæ.

7. *Apsopelix sauriformis* Cope.

Apsopelix sauriformis Cope. Rept. U. S. Geol. Surv. Terr. 424; 1870. (Benton Cretaceous.)

A long and slender fish (No. 264), fairly preserved, from the Niobrara formation, Benton Cretaceous. Lincoln county, Kansas. Collector, Rev. W. S. Price. The head is broken and the vertical fins mostly destroyed. Length, with caudal, 17½ inches. (Plate XX.)

Head 3⅖ in length to base of caudal; depth, 4⅚; mandible, 2 in head; eye, 4¼; pectoral, 1⅘ in head; ventral, 2⅔; caudal lobes about 1½; pectoral rays about 12; ventral about 12; dorsal and anal mostly obliterated, the former with about 4 interneurals present, just before the ventrals apparently representing the last rays; caudal rays $9 + 9 = 18$; vertebræ, $20 + 27 = 47$; 20 from base of ventrals backward.

Body long and slender, compressed, deepest opposite ventral, the caudal peduncle slender, the belly apparently not cultrate; head long, low, its upper profile evenly rising; mouth very large, the narrow maxillary extending well beyond eye; with small, nearly even teeth; mandible strong, perhaps projecting.

Pectoral broad, inserted very low; ventrals broad, inserted very far back, rather nearer base of caudal than pectorals; rays of pectorals and ventrals all slender, the inner progressively so. Distance from base of pectoral to ventral, 2⅓ in body. Pelvic bone extremely large and broad, heart-shaped, basinlike, with a longitudinal bounding ridge. Caudal lobes strong; deeply but not widely forked; no trace of anal preserved, the fin, if existing, beginning not far behind ventrals and relatively short, as the caudal portion of the vertebral column is contained 3¾ times in body. No trace of dorsal except about 5 small interneurals just above insertion of ventrals and with a few detached broken rays further forward. There was probably a single short dorsal fin, as in *Leptichthys* and *Albula*.

Vertebræ small, about as deep as long, the anterior with a bluntish median ridge; traces of moderate-sized scales on different parts of

body. Abdominal cavity (filled with chalk in specimen examined) extending backward from ventral fin a distance about 1½ times length of fin.

In Mr. Atkinson's accompanying restoration (Plate XX) of this species, the dorsal is provisionally placed over the interneurals, as shown by our specimen. In *Leptichthys agilis*, as figured by Stewart, this fin is certainly further forward, over last third of the length of the pectoral.

LEPTICHTHYS Stewart.

(Type *Leptichthys agilis* Stewart.)

This genus is closely related to *Apsopelix*, differing in the anterior insertion of the dorsal fin, which is well in advance of the ventrals. An imperfect specimen examined by me differs in some other respects from *Apsopelix*, especially in the smaller size of the ventrals.

In *Apsopelix sauriformis* the ventrals show 12 or 13 rays, the vertebræ $(27 + 20 = 47)$ are shorter and smoother; the distance from caudal base to ventrals is 3 in distance to snout. Last interneurals of dorsal over ventrals.

In *Leptichthys agilis* the last-named distance is 3½ from ventrals to snout; ventral rays, 8; vertebræ $(27 + 18 = 45)$ more elongate and three-ridged; dorsal all well before ventrals, its insertion above tip of pectorals.

In *Apsopelix sauriformis* the location of the dorsal has not been indicated, except indirectly, as involved in the statement of Stewart that it is farther back than in *Leptichthys*—a statement borne out by my example of *Apsopelix*. Nothing is known of the anal fin, if it exists, in either genus.

8. *Leptichthys agilis* Stewart.

Leptichthys agilis Stewart. Amer. Geol., XXIV, 79, 1899. Niobrara Cretaceous, Logan county, Kansas; Geol. Surv. Kansas, VI, 372; 1900; Plate LXXI, Fig. 1.

Of this species I have seen but one example, an imperfect head with vertebral column seen from below. This specimen is shown on Plate XXI. The differential characters I note are given above. If those do not indicate generic distinction, they mark at least distinct species of *Apsopelix*.

FAMILY PHAREODONTIDÆ.

EURYCHIR Jordan, new genus.

(Type *Eurychir lindleyi*, new genus.)

This genus seems closely allied to *Phareodus* Leidy (*Dapedoglossus* Cope) differing in the larger mouth, smaller and more wide-set teeth, and in the enormous development of the first ray of the pectoral fin.

The specimen before me resembles *Phareodus testis* (Cope), differing in having the first pectoral ray enormously enlarged and flattened. In *Phareodus testis* the ray is much narrower and has its inner edge more or less serrate. The mouth is larger, the teeth much shorter, thicker and less oppressed than in *Phareodus*. For these reasons, and because *Phareodus* is thus far known only from the Eocene, we give it a new name, generic and specific, the last in honor of my former student, Dr. Ernest H. Lindley, chancellor of the University of Kansas.

Eurychir must be allied to Phareodus, having the general form, so far as can be seen, with the elongate first ray of the pectoral characteristic of *Phareodus*. According to Cope, *Phareodus*, at first known from jaws only, is the same as his *Dapedoglossus*, in which case Leidy's name, being the older, must be accepted, although its author did not separate a generic diagnosis from the account of the species, *Phareodus acutus*.

I doubt whether *Phareodus* and *Eurychir* should be placed with the Osteoglossidæ. *Phareodus* agrees with *Osteoglossum* in the produced pectoral ray, and to some extent in the character of the scales, but the broad lunate caudal fin is very different from the small rounded fin of *Osteoglossum*. All the living Osteoglossidæ are large river fishes of the tropics, while these American forms must have been marine. In *Phareodus* and *Eurychir* we find no trace of the bony casque characteristic of *Osteoglossum*.

9. *Eurychir lindleyi* Jordan, n. sp.

Type No. 249. From the Niobrara Cretaceous. Collector, Harry Martin.

A crushed head of a very large fish, with a few vertebæ and a broken pectoral fin. (Plates XXII and XXIII.) The first ray of this fin is very long and broad, its surface smooth and its edges entire, the ray narrowed towards the base. This fin, with its long and widened ray, must have been much longer than head, at least

five inches in length, its median width three times its basal width. The second ray is one-third the width of the upper one, being, like it, broadened mesially and towards the deeply divided tip.

Anterior vertebræ strong, longer than deep, with a single pit on lower side and without distinct groove or ridge above, each with robust transverse process for attachment of ribs; ribs very slender; mouth large, its length about two-thirds head; the mandible strong, with a single row of rather short, slender teeth, moderate, apparently in one row, those in front slightly larger, but with no trace of canines nor of an inner series. Teeth much shorter than those of *Phareodus testis*, not so slender, and not closely appressed.

The parts of the head can be traced, although misplaced. These are numbered on the plate as follows:

1. Mandible basally very broad, its oblique width two-fifths apparent length of head; the anterior portion with rather strong cylindrical wide set teeth; cleft of mouth straight.
2. Parasphenoid evident, rather long and strong, straight.
249. Preopercle strong, with a rounded anterior ridge.
3. Opercle broken, flat, roughish, but without radiating striæ, its form rather short and deep.
4. Gill structures narrow and the parts pressed together.
5. Quadrate bone obscure.
6. Pectoral spines of some other fish seen from the under side.
7. Coracoid, broad with a large foramen.
8. Scapula, broad, broken.
9. Cleithrum—lower part of inner side of shoulder girdle.
10. Articular facet of enlarged pectoral ray.
11. Actinosts strong.

This fish seems to be related to *Phareodus testis* Cope, characteristic of the Eocene Green river shales at Fossil, Wyoming. Compared with our photographs of the latter, it differs in the very much broader upper pectoral ray, and in the smaller, stouter and more widely separated teeth. *Phareodus testis* is a species of the Eocene, while our species belongs to the Cretaceous. *Phareodus acutus* Leidy (Proc. Ac. Nat. Sci. Phila., 1878, 99), from the Bridger Eocene, known from jaws only, is figured by Cope as having also teeth much larger and slenderer than those of *Eurychir lindleyi*.

DESCRIPTION OF PLATES.

PLATE XIII.

FIG. 1. *Anogmius polymicrodus* Stewart. Caudal fin. Cat. No. 273, K. U. museum.

FIGS. 2 and 3. *Anogmius polymicrodus.* Maxillary and dentary. Cat. No. 283, K. U. museum.

PLATE XIV.

FIG. 1. *Niobrara encarsia* Jordan, new genus, new species. Type specimen. Cat. No. 179, K. U. museum.

FIG. 2. *Niobrara encarsia.* Restoration.

PLATE XV.

FIG. 1. *Zanclites xenurus* Jordan, new genus, new species. Type specimen. Cat. No. 52, K. U. museum.

FIG. 2. *Zanclites xenurus* Jordan. Restoration.

PLATE XVI.

Kansanus martini Jordan, new genus, new species. Type specimen. Cat. No. 128, K. U. museum.

PLATE XVII.

Luxilites striolatus Jordan, new genus, new species. Type specimen. Cat. No. 295, K. U. museum.

PLATE XVIII.

Ferrifrons rugosus Jordan, new genus, new species. Type specimen. Cat. No. 296, K. U. museum. (Partly restored, the dorsal fin fallacious, as also neural spines.)

PLATE XIX.

Ferrifrons rugosus Jordan. Restoration.

PLATE XX.

FIG. 1. *Apsopelix sauriformis* Cope. Cat. No. 264, K. U. museum.

FIG. 2. *Apsopelix sauriformis* Cope. Restoration.

PLATE XXI.

Leptichthys agilis Stewart. Cat. No. 312, K. U. museum.

PLATE XXII.

Eurychir lindleyi Jordan, new genus, new species. Type specimen. Cat. No. 249, K. U. museum.

PLATE XXIII.

Eurychir lindleyi Jordan. Restoration.

PLATE XIII.

PLATE XIV.

PLATE XV.

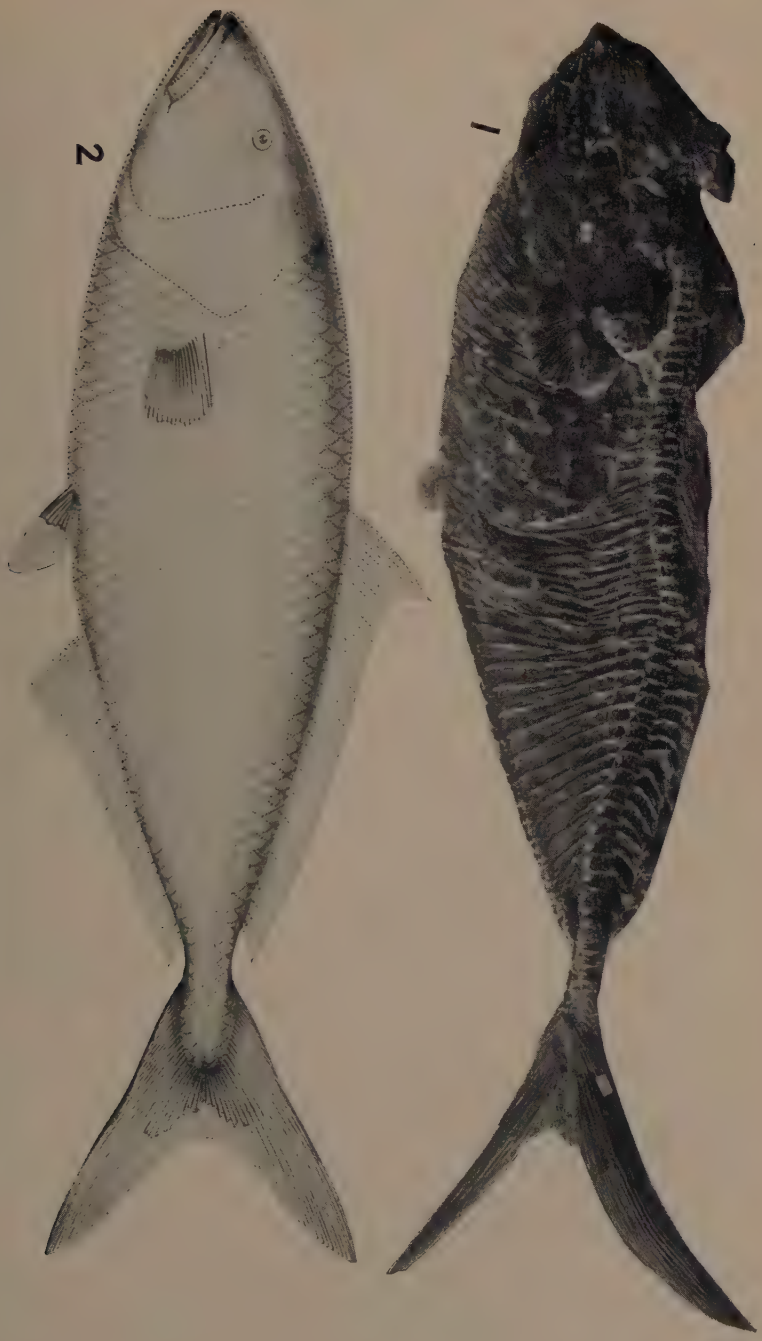

PLATE XVI.

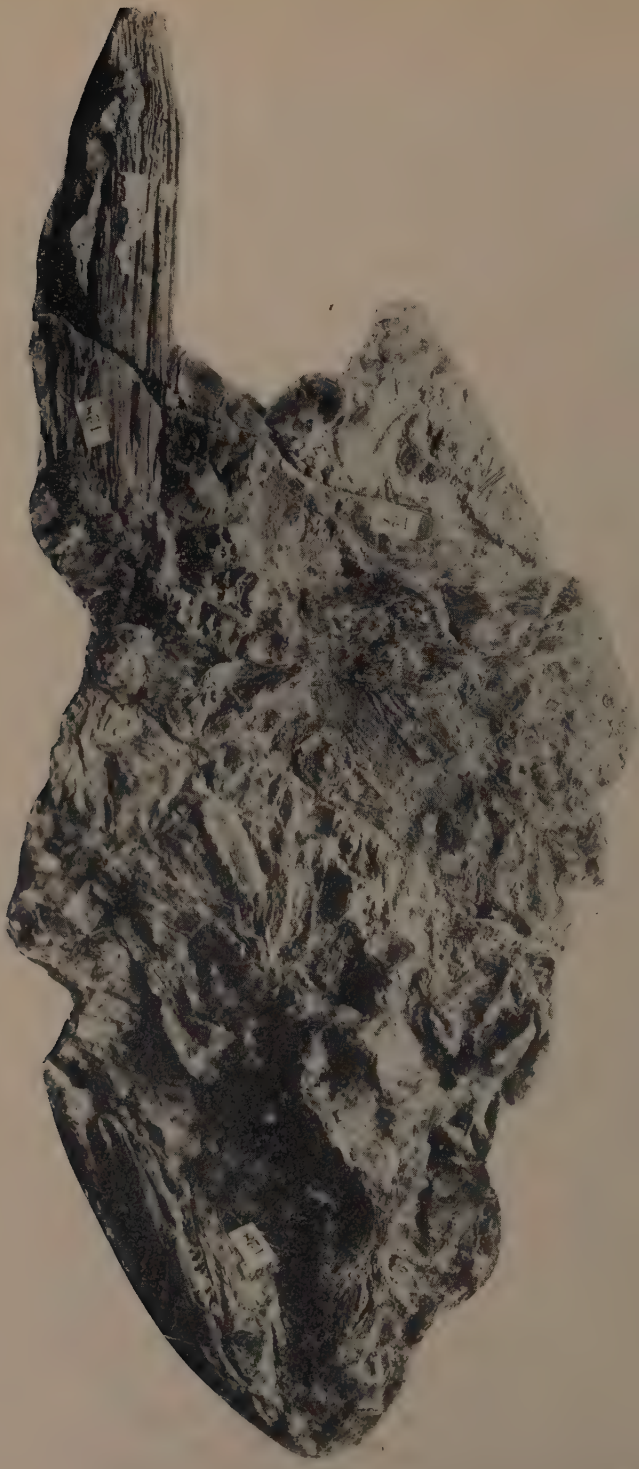

PLATE XVII.

PLATE XVIII.

PLATE XIX.

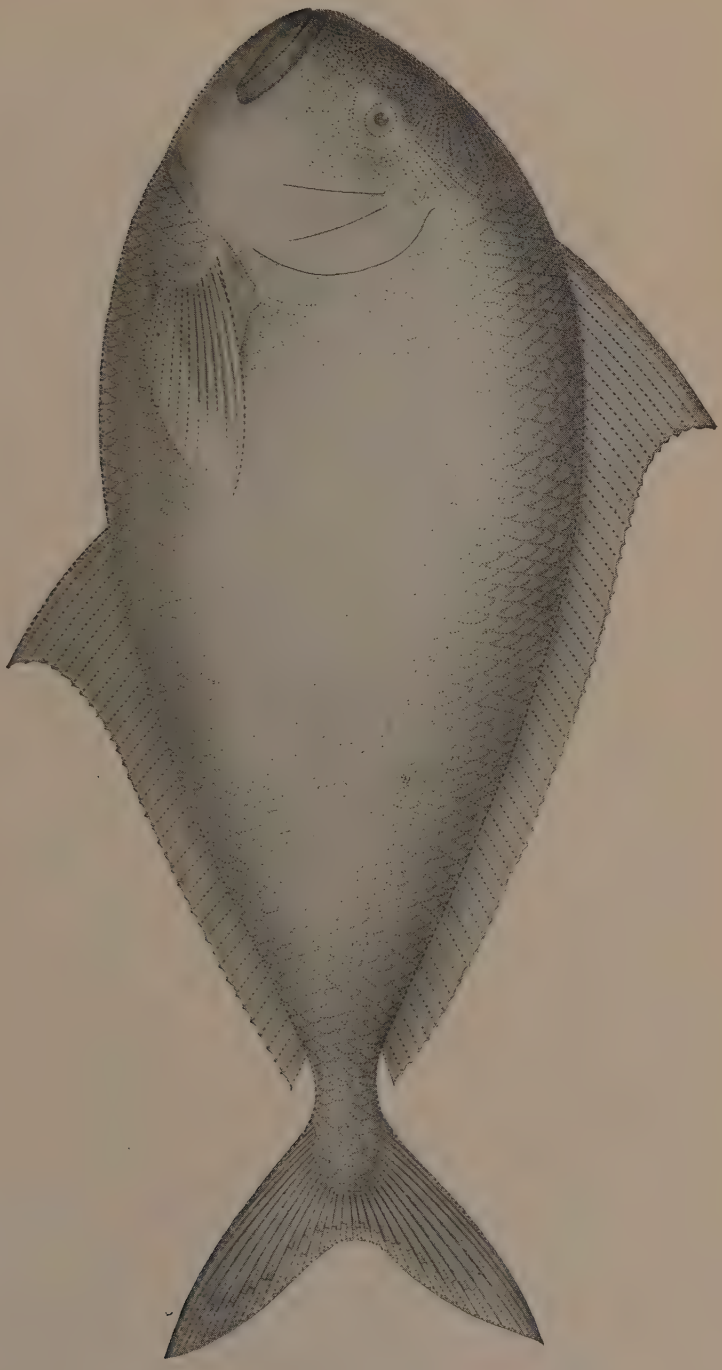

PLATE XX.

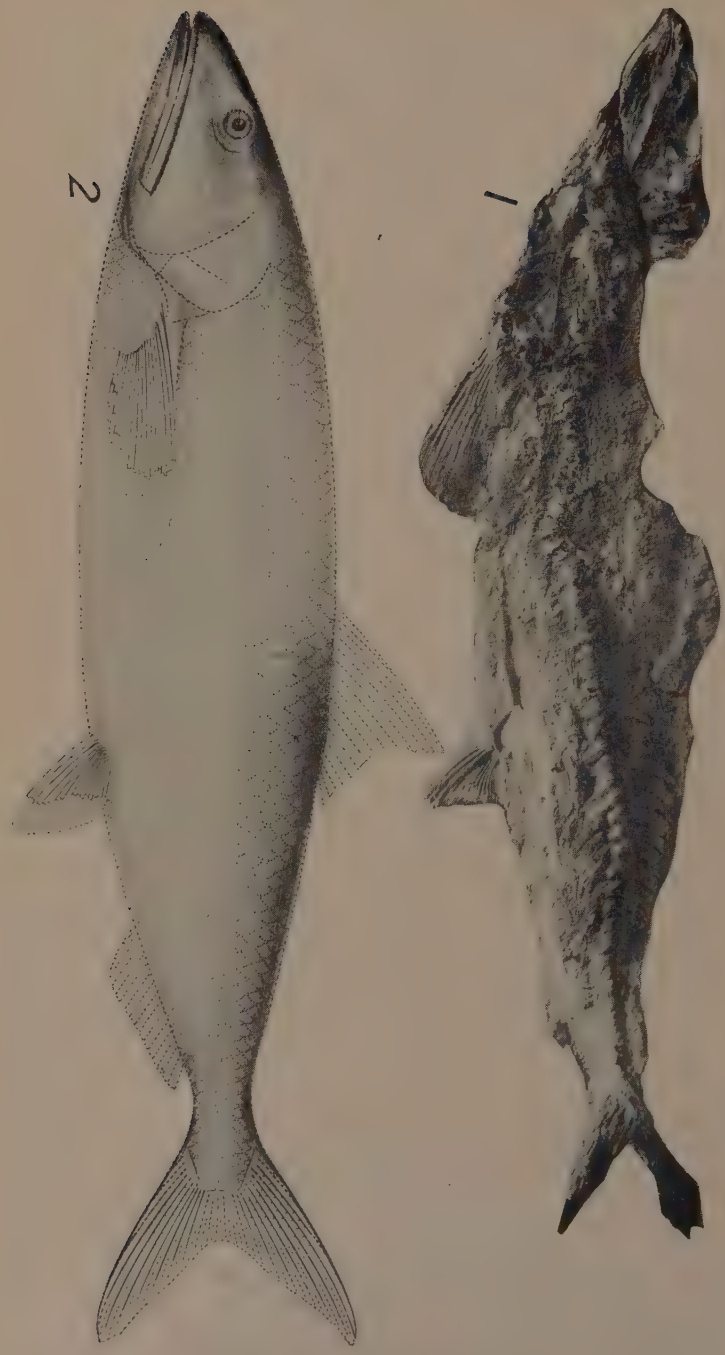

PLATE XXI.

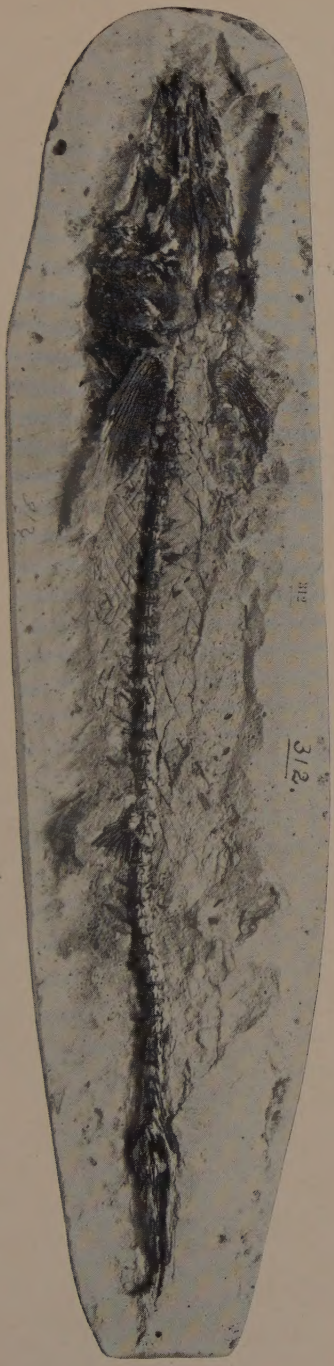

PLATE XXII.
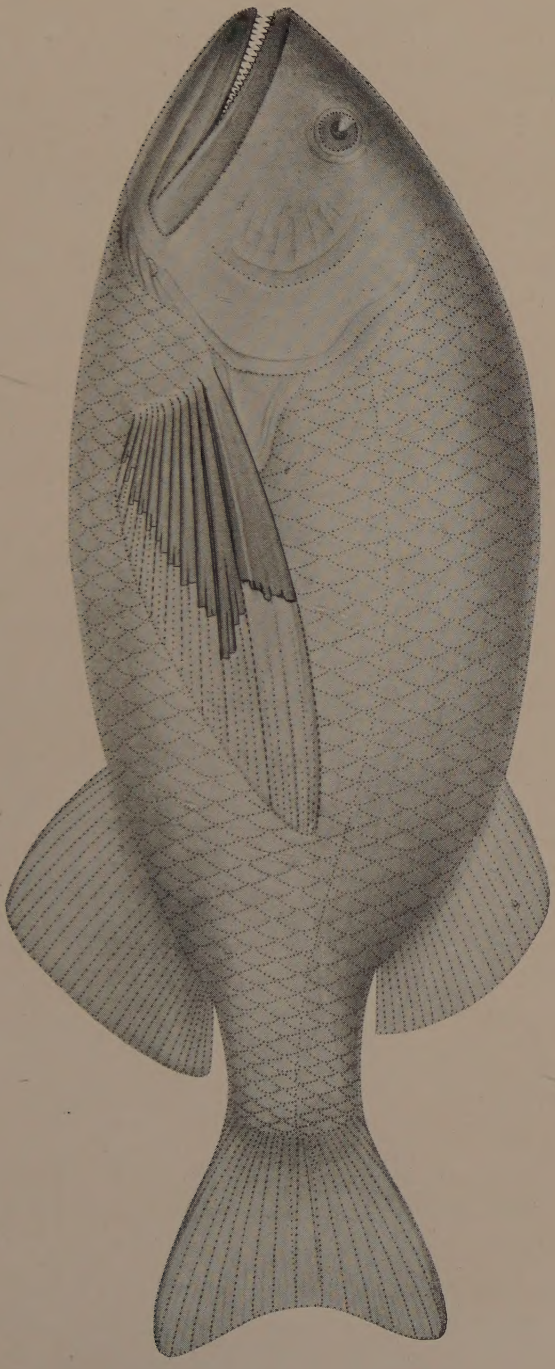
PLATE XXIII.